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**INTERNATIONALE ANMELDUNG VERÖFFENTLICH NACH DEM VERTRAG ÜBER DIE
INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT)**

(51) Internationale Patentklassifikation 7 : H04L 27/26, 25/03		A1	(11) Internationale Veröffentlichungsnummer: WO 00/60822 (43) Internationales Veröffentlichungsdatum: 12. Oktober 2000 (12.10.00)
(21) Internationales Aktenzeichen: PCT/DE00/00699		(81) Bestimmungsstaaten: CN, JP, US, europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).	
(22) Internationales Anmeldedatum: 6. März 2000 (06.03.00)			
(30) Prioritätsdaten: 199 14 797.3 31. März 1999 (31.03.99) DE		Veröffentlicht <i>Mit internationalem Recherchenbericht. Vor Ablauf der für Änderungen der Ansprüche zugelassenen Frist; Veröffentlichung wird wiederholt falls Änderungen eintreffen.</i>	
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<p>(54) Title: METHOD, USE OF SAID METHOD AND RECEIVER SYSTEM FOR RECEIVING MULTI-CARRIER SIGNALS PRESENTING SEVERAL FREQUENCY-DISCRETE SUBCARRIERS</p> <p>(54) Bezeichnung: VERFAHREN, VERWENDUNG DES VERFAHRENS UND EMPFANGSANORDNUNG ZUM EMPFANG VON MEHRERE FREQUENZDISKRETE SUBTRÄGER AUFWEISENDEN MULTITRÄGERSIGNALEN</p> <p>(57) Abstract</p> <p>In a received multi-carrier signal (ms) which presents subcarrier-specific interference (ici0) caused by adjacent subcarriers (st1...n) said subcarriers (st1...n) are additionally subjected to interference in a targeted manner and a correction information (ici0pt) which represents the subcarrier-specific interference (ici0) is derived from the subcarriers (st1...n). The received subcarriers (st1...n) are then corrected by means of the correction information. Low-cost oscillators can advantageously be used to produce economical transmitter and receiver units.</p>			

Patent Claims

1. A method for receiving a multicarrier signal (ms) having a number of frequency-discrete subcarriers (st1...n) and into which information is inserted which is converted by means of a multicarrier method to frequency-discrete modulation-specific modulation symbols with the individual frequency-discrete subcarriers (st1...n) of the multicarrier signal (ms) transmitted via a transmission medium (FK) each being subject to subcarrier-specific disturbances (ici0) caused by subcarriers (st1...n) arranged adjacent in the frequency domain,
15 characterized
 - in that the subcarriers (st1...n) of the received multicarrier signal (ms) are additionally deliberately subjected to disturbances,
 - in that correction information (ici_{opt}) which represents the subcarrier-specific disturbances (ici0) is derived from the subcarriers (st1...n) which have been additionally deliberately subjected to disturbances, and
 - in that the subcarriers (st1...n) of the received multicarrier signal (ms) are corrected in accordance with the determined correction information (ici_{opt}).
- 30 2. The method as claimed in claim 1,
characterized in that a number of different test disturbances (icix) are provided, with the subcarriers (st1...n) being deliberately subjected to disturbances, in the event of a test disturbance
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(icix), by means of constant or frequency-dependent disturbance information (icil...4).

3. The method as claimed in claim 2,

5 characterized

- in that the received symbols (es1...n) which represent frequency-discrete subcarriers (st1...n) are derived from the received multicarrier signal (ms),
- in that k differently defined reference disturbance information items (icil...4) are provided, in which case, for each reference disturbance information item (icil...4),

- 5 -- (a) the received symbols ($es_1\dots n$) in the
 subcarriers ($st_{1..}, st_{i..}$) which are in
 each case arranged adjacent around at
 least some of the subcarriers (st_i) in
 the frequency domain are each subjected
 to disturbances from the reference
 disturbance information ($icil\dots 4$), and
 the disturbed received symbols in the
 adjacent subcarriers ($st_{1..}, st_{i..}$) are
 then additively superimposed as
 deliberate test disturbances ($icix_{1..}$,
 $icix_{i..}$) on the received symbol ($es_1\dots n$)
 in the additionally disturbed subcarrier
 (st_i),
- 10 15 - (b) in that the additionally deliberately
 disturbed received symbols ($es'_1\dots n$)
 are each compared with the closest
 modulation-specific modulation symbol,
 and subcarrier-specific error
 information ($\Delta es_1\dots n$) is formed as a
 function of the comparison results, and
- 20 25 -- (c) disturbance-information-specific sum
 error information ($se_1\dots k$) is formed
 from the subcarrier-specific error
 information ($\Delta es_1\dots n$), and
- 25 30 - (d) in that the correction information
 (ici_{opt}) is derived from the k reference
 disturbance information items ($icil\dots k$)
 and the k sum error information items
 ($se_1\dots k$).
4. The method as claimed in claim 3,
 characterized
 - in that the frequency-discrete received symbols
 ($es_1\dots n$) derived from the received
 multicarrier signal (ms) are delayed or are

temporarily stored until the correction information (ici_{opt}) has been established,

- (e) in that the delayed received symbols (ves₁...n) in the subcarriers (st_{i-1}, st_{i+1}) which are in each case arranged adjacent around a subcarrier (st_i) in the frequency domain are each corrected by the determined correction information (ici_{opt}), and are then additively superimposed on the delayed received symbol (ves₁...n) in the subcarrier (st_i).

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5. The method as claimed in claim 3 or 4,
characterized

in that the k reference disturbance information
items ($i_{ci1} \dots k$) and the k disturbance-
information-specific sum error information items
($s_{el1} \dots k$) derived from them are used to establish
a correction function (KF) which is used to
calculate the correction information ($i_{ci_{opt}}$).

10 6. The method as claimed in claim 5,
characterized

- in that four defined reference disturbance
information items ($i_{ci1} \dots 4$) are provided, and
are used to derive the four disturbance-
information-specific sum error information
items ($s_{el1} \dots 4$) and
- in that the correction information ($i_{ci_{opt}}$) is
calculated by

$$i_{ci_{opt}} = \left(\frac{i_{ci4} - \frac{(s_{el1} + s_{el3})}{2}}{2(s_{el1} - s_{el3})} \right) - (i_{ci1} - i_{ci3}) + \frac{i_{ci4}}{2}$$

20 where

$s_{el1} \dots 4$ represents the four sum error
information items ($s_{el1} \dots 4$), and
 $i_{ci1} \dots 4$ represents the four reference
disturbance information items ($i_{ci1} \dots 4$).

25 7. The method as claimed in claim 3 or 4,
characterized

30 in that the correction information ($i_{ci_{opt}}$) is
determined in the course of an iterative search,
with the k reference disturbance information items
($i_{ci1} \dots 4$) being established in the course of the
iterative search, and the steps (a) to (c) being

repeated until a minimum value of the disturbance-information-specific sum error information (ϵ_{\min}) is determined, and the correction information ($i_{ci_{op}}$) has been derived from this.

8. The method as claimed in one of claims 3 to 7,
characterized
in that the additionally deliberately disturbed
received symbols ($es'1\dots n$) are in each case
corrected by equalization as a function of
frequency-selective transmission characteristics
($H(f)$) of the transmission medium (FK) before the
comparison with the respective closest modulation-
specific modulation symbol.
9. The method as claimed in one of claims 3 to 8,
characterized
- in that, once steps (a) to (d) have each been
carried out for each reference disturbance
information item ($icil\dots 4$)
-- (a') the received symbols ($es1\dots n$) of the
subcarriers ($st_{1\dots b}$, where $b > 1$)
which are each arranged further away
from at least some of the subcarriers
(st_i) in the frequency domain are each
subjected to disturbances from the
reference disturbance information
($icil\dots 4$), and the disturbed received
symbols are then additively superimposed
as deliberate test disturbances ($icix_{1\dots b}$)
on the received symbol ($es1\dots n$)
of the additionally disturbed subcarrier
(st_i), and
-- steps (b) to (d) are then carried out.
10. The method as claimed in one of claims 2 to 9,
characterized
- in that the received symbols ($ves'1\dots n$) which
have been corrected using the correction
information (ici_{opt}) are demodulated.,

- in that errors are identified in the demodulated received symbols (d_i) using error identification information inserted into the transmitted information, and identified, erroneous received symbols ($es'1\dots n$, $es''1\dots n$) are corrected,
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- in that, when errors are identified, steps (b) to (d) are carried out once again, with the corrected received symbols ($es'1\dots n$, $es''1\dots n$) being used for determining the
10 correction information (ici_{op}).

11. The method as claimed in one of the preceding claims,
characterized
in that the multicarrier method is provided by
means of an OFDM transmission method - Orthogonal
Frequency Division Multiplexing - or by means of a
transmission method based on discrete multiple
tones - DMT.
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- 10 12. The method as claimed in one of the preceding
claims,
characterized
in that the transmission medium is in the form of
a wireless radio channel or a cable-based or wire-
based transmission channel.
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13. The method as claimed in claim 12,
characterized
in that the information is transmitted via power
supply lines.
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14. Use of the method according to the invention as
claimed in one of the preceding claims,
characterized
25 - in that the received multicarrier signal (ms)
is demodulated,
- in that errors contained in the demodulated
multicarrier signal (di) are identified using
an error handling routine and are corrected,
- in that the method is carried out in order to
30 deliberately disturb the received multicarrier
signal (ms) as a function of the number and
correctability of the errors.
- 35 15. A receiving arrangement for receiving a
multicarrier signal (ms) having a number of

frequency-discrete subcarriers ($st_1 \dots n$) and into which information is inserted which is converted into frequency-discrete modulation symbols by means of a multicarrier method,

5 with the individual frequency-discrete subcarriers ($st_1 \dots n$) of the multicarrier signal (ms) transmitted via a transmission medium (FK) each being subject to subcarrier-specific disturbances (ici0)

caused by subcarriers ($st1\dots n$) arranged adjacent in the frequency domain,

characterized

- in that disturbance means (RM1..4) are provided for additional, deliberate disturbance of the received multicarrier signal (ms),
- in that means (ASW) are arranged for deriving correction information (ici_{opt}), which represents the subcarrier-specific disturbances ($ici0$), from the additionally deliberately disturbed subcarriers ($st1\dots n$, $es'1\dots n$, $es''1\dots n$), and
- in that means (KE) are provided for correction of the frequency-discrete subcarriers ($st1\dots n$, $ves1\dots n$) as a function of the determined correction information (ici_{opt}).

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Abstract

Method, use of the method and a receiving arrangement for receiving multicarrier signals having a number of frequency-discrete subcarriers

In a received multicarrier signal (ms) which is subject to subcarrier-specific disturbances (ici_0) caused by adjacent subcarriers ($st1\dots n$), the subcarriers ($st1\dots n$) are additionally deliberately subjected to disturbances, and correction information (ici_{opt}) which represents the carrier-specific disturbances (ici_0) is derived from the subcarriers ($st1\dots n$) which have been additionally deliberately subjected to disturbances and is then used to correct the received subcarriers ($st1\dots n$). Low-cost oscillators can advantageously be used to provide cheap transmitting and receiving units.

FIG 2